

SWIMMING

Swimming is one of the best forms of physical conditioning. It strengthens the cardiovascular system and involves the major muscle groups of both the upper and lower body. It also develops flexibility and strength in the muscles and joints as the swimmer performs a wide range of motion against the water's resistance. Since the body and limbs are rhythmically stretched in swimming, it is possible to warm-up and cool-down in the water by doing slow and simple strokes.

An important consideration for a person with an amputation is that swimming is not traumatic to the residual limb. The water's buoyancy evenly distributes and supports the weight of the body; there is no danger of falling, and there are no impact forces on the residual limb.

Many recreation centers offer instructional programs for people with physical disabilities. Nonswimmers should consider joining a special swim instruction program that includes techniques for entering and leaving the pool. Even someone who was a good swimmer before lower limb loss may need to modify some techniques such as a kick-turn at the wall (some swimmers may need to use their hands as well as their feet).

GETTING IN AND OUT OF THE WATER

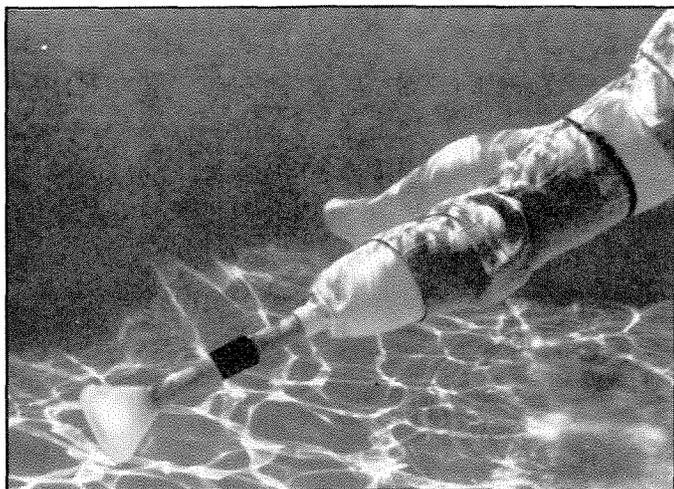
Most problems connected with swimming are associated with getting in and out of the pool, lake, or ocean. Pool areas are wet and slippery; rocks and

shells found at the beaches can be dangerous. Hopping to and from the water is not safe, and the use of a swim prosthesis, peg leg, or crutches is always recommended.

Those who choose not to use a prosthesis while swimming can remove it and leave it near the water's edge or poolside near the ladder (at a public pool the prosthesis should be covered with a towel so that its presence does not offend anyone). However, the prosthesis should not be left in areas where others are entering and leaving the pool (e.g., near steps or diving boards). If the prosthesis is not waterproof, the swimmer may prefer to leave it in the locker room and enter the pool area using crutches. Crutches should be left by the poolside so they are accessible when the swimmer gets out of the water.

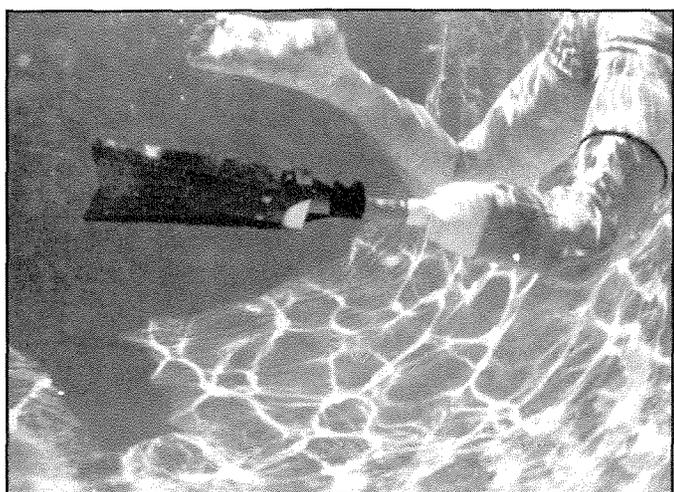
Swimmers without a prosthesis can enter the pool using built-in stairs, a special swimming lift, or by simply jumping or diving into the water. If necessary, built-in stairs can be negotiated by sitting on the steps and using the hands to move the body into or out of the water. If the prosthesis is not left by the poolside, some individuals may require assistance in lifting themselves out of the water. If needed, a wheelchair can be used to get a swimmer to the pool and a hoist can be used to lower him/her into the water.

Swimming alone in a pool is a pleasure for a competent swimmer, but in an ocean or lake it is not recommended for anyone. Swimmers will find it wise to have a swimming partner or an observer in



RICHARD SIMS, SEATTLE, WA

A swim prosthesis made of a supracondylar BK socket with neoprene suspension sleeve and Orthomedics Pylon/Peg.



RICHARD SIMS, SEATTLE, WA

A flipper is attached to the prosthesis for increased underwater swimming propulsion. This leg also provides for easy movement into and out of the water.

case a problem develops and immediate assistance is needed. A strong current, fatigue, or other unforeseen circumstances may make it necessary to return to the shore. If the swimmer is some distance away from where the prosthesis or crutches were left, it could be difficult to hop or crawl to reach them. Wearing a swim prosthesis avoids the problem of entering and leaving the water in two different places.

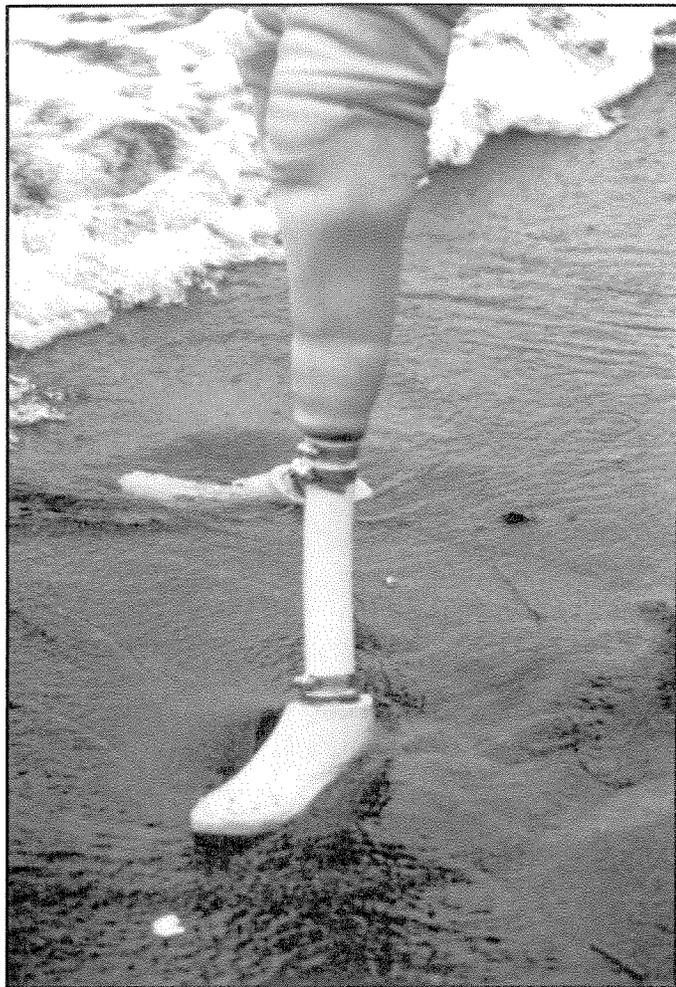
ADAPTIVE TECHNIQUES

Although a person can certainly enjoy swimming without the use of a prosthesis, there are definite advantages in wearing one. A waterproof or swim prosthesis provides balance in the water through even weight distribution. Without a prosthesis, a swimmer with unilateral amputation may find that the body tends to pull or drift to the side of the sound leg. Swimming within the lanes of a pool or sighting certain markers in open water will help in keeping on a straight line when swimming without a prosthesis.



SHIRLEY FORSGREN/PROSTHETICS RESEARCH STUDY, SEATTLE, WA

Exoskeletal BK prosthesis with Seattle Foot used for everyday walking, sports, etc. When the ActivSleeve is used and New Skin is applied, the prosthesis may double as a waterproof leg for swimming. Because of its rigid foam base, the leg is buoyant but can be used for swimming in a pool. When diving, a weight belt is needed to compensate for the buoyancy.



DREW HITTENBERGER, CP/PROSTHETICS RESEARCH STUDY,
SEATTLE, WA

Bilateral BK prostheses with polypropylene sockets, adjustable PVC pylons, and waterproof SAFE feet. Michigan Suspension Sleeves are used to prevent water from entering the socket and provide good suspension. (For more information, see D. Hittenberger: A Thermoplastic Endoskeletal Prosthesis. *Orthotics and Prosthetics*, 37(2), 45-52, 1983.)

A prosthesis will also add power to the swimming strokes. For example, when using a kickboard without a prosthesis, there may be no problem kicking, but the swimmer will remain in place. Without the power of both legs, it may be necessary to use the arms in order to proceed.

Doing kick-turns to push off from the pool wall is the same with a prosthetic swim leg as for any two-legged swimmer. For increased speed, it is to the advantage of the swimmer to master the kick-turn. However, those who swim without a swim leg need to compensate for loss of power by developing

their own techniques to push off from the pool wall with only one foot. If turning over is a problem, a swimmer can use both hands to touch the wall and push off with one leg. A swimmer with a bilateral amputation can simply touch the wall with one hand and then push off the wall with one or both hands.

SWIM PROSTHESES

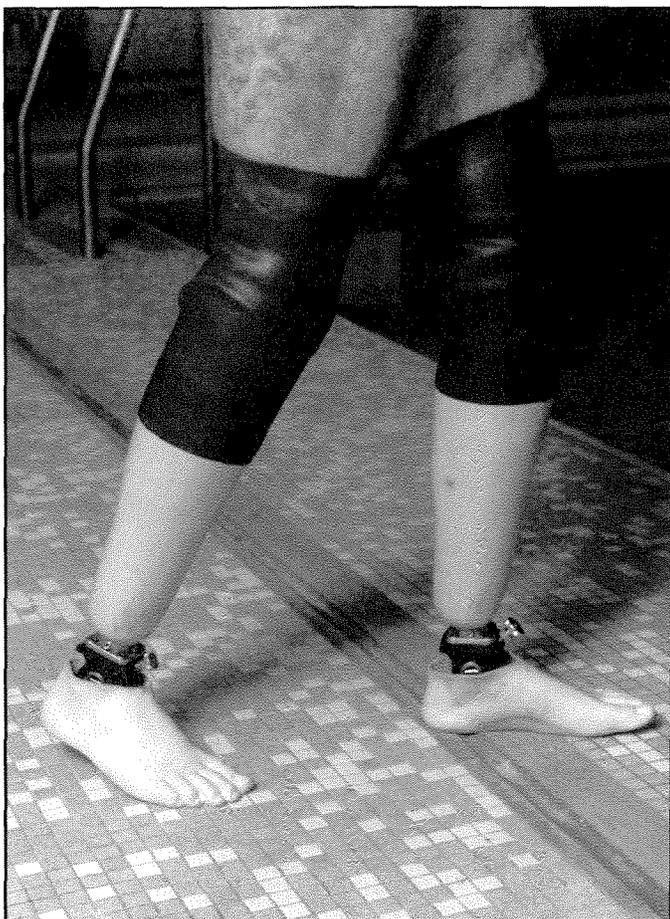
If swimming is to be a regular activity, a waterproof prosthesis or a special swim leg is a worthwhile investment. For those with bilateral amputations, a swimming prosthesis helps to get in and out of the water. A prosthesis with a fin attached adds power to the kicking motion, strengthening the muscles in the residual limb.

There are many types of swim legs, including the waterproofed everyday walking leg, peg leg, stubbies, and the hollow-chambered leg that compensates for buoyancy. Buoyancy control is important for underwater swimming and for skin or scuba diving. If a non-hollowed leg is used, buoyancy can be controlled by adding a weight belt and using a buoyancy-compensation vest. Swim/walk legs and ankles also can be designed to be held in an extended plantar-flexed position for use with fins. Individualized combinations can be made as well.

Below-Knee Adaptations

Waterproof prostheses for people with BK amputations can be made from a regular walking leg treated with New Skin. A cuff suspension made of leather, Dacron™, or cotton straps will not work well for swimming because these materials are not waterproof. A plastic, waterproof version is available from Otto Bock® Orthopedic Industry Inc., but it will not keep water from entering the socket. Use of a rubber suspension sleeve like the ActivSleeve, Michigan Sleeve, or Otto Bock Swimming Sleeve will keep water from entering the socket, protect the liner, and keep stump socks dry. After leaving the water, walking with wet stump socks can cause blisters. Therefore, keeping the inner socket and residual limb dry is very important in preventing skin breakdown and blisters.

Hard sockets are preferable, because they are easy to clean and dry. If liners are used, they should be made from a fast-drying, nonporous material. A



SUSAN BROWN/VAMC, SAN DIEGO, CA

Hollow-chambered exoskeletal BK swim prostheses. The ActivAnkle can place the foot in a position for walking (90 degrees) or flex to accommodate swim fins (160-180 degrees). ActivSleeve suspension helps to prevent water from entering the sockets. Carbon Copy II Syme's feet are used along with Otto Bock Titanium Rotatable Socket Adapters on the hollow-chambered legs to compensate for buoyancy.

spare liner should be available for use while the other is drying. A hair dryer will dry a wet liner quickly (care must be taken not to distort the liner by overheating).

Above-Knee Adaptations

Swimmers with AK amputations can use straight exoskeletal prostheses without a knee or use a peg leg. The 3K9 or 3K5 Otto Bock leg, which locks the knee in extension for walking in the water and bends while seated, is an excellent swim prosthesis. It is water resistant and has a plastic knee. The shank can be hollowed out, as can the area below



SUSAN BROWN/VAMC, SAN DIEGO, CA

The hollow-chambered exoskeletal prosthesis fills with water to compensate for buoyancy while swimming or diving. Out of the water, the leg is drained as shown. An additional airhole on the posterior proximal portion of the legs allows water to drain (and fill) more quickly.

the socket, to make the prosthesis lightweight in the water. The hollow shank will allow water to fill up inside, controlling buoyancy, and will drain when the swimmer leaves the water. The leg comes apart at the knee for easy storage.

Above-knee suction suspension can be enhanced with a plastic hip-belt from Otto Bock or a TES belt made of neoprene. The suction suspension is usually adequate for everyday activities, but when swimming, adding a belt will assure that the limb will stay in place.

PROSTHETIC FOOT ADAPTATIONS

Regardless of the level of amputation, the type of foot used in a swim prosthesis is important.



JOE ZETTL, CP/AMERICAN ARTIFICIAL LIMB CO., SEATTLE, WA
Lightweight exoskeletal BK prosthesis with waterproof Beachcomber Foot (Kingsley Manufacturing) and fixed ankle. The Michigan Sleeve is used for suspension. The prosthesis is hollowed out for water entry, to compensate for buoyancy. Water drains out of an opening on the bottom of the foot.

Certain styles of the SACH Foot, Seattle Foot, SAFE Foot, and Dynamic Foot are best in the water. These feet are molded without an external heel cushion, making them less susceptible to becoming water-logged. Feet with external foam cushion heels and many standard SACH Feet, however, will absorb water like a sponge.

Any foot used for swimming should be treated with New Skin or waterproof foot paint, like that available from Otto Bock, Skoat Coat from DAW, or Ultradip. This is also true for any endoskeletal foot that has a soft foam cover, such as Endolite or Quantum. (Flex-Foot uses a special E.V.A. foam



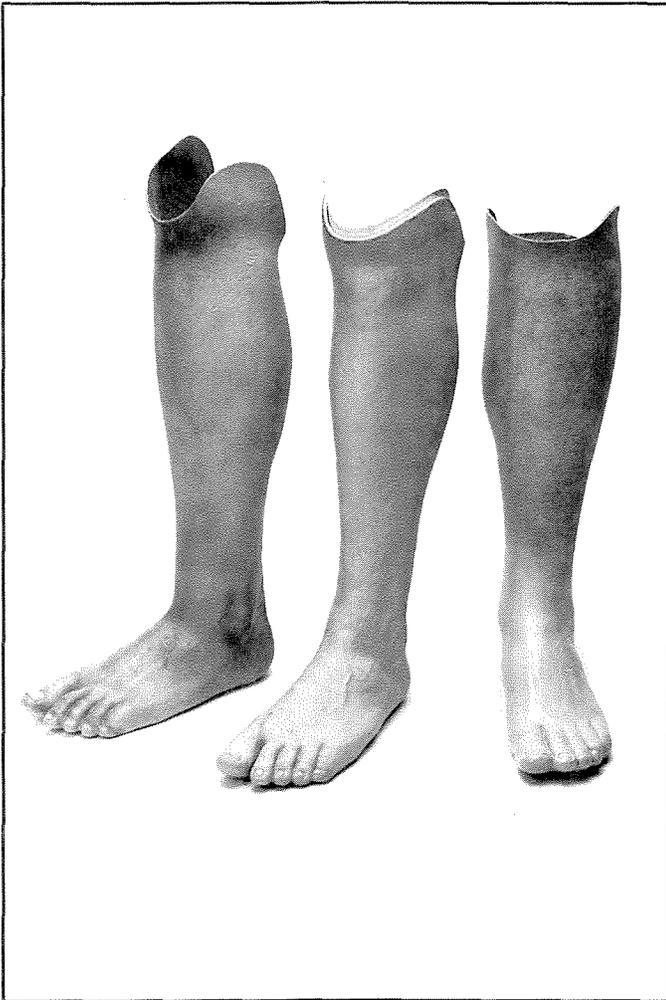
JOE ZETTL, CP/AMERICAN ARTIFICIAL LIMB CO., SEATTLE, WA
A swimmer wearing the hollow exoskeletal prosthesis and waterproof Beachcomber Foot.



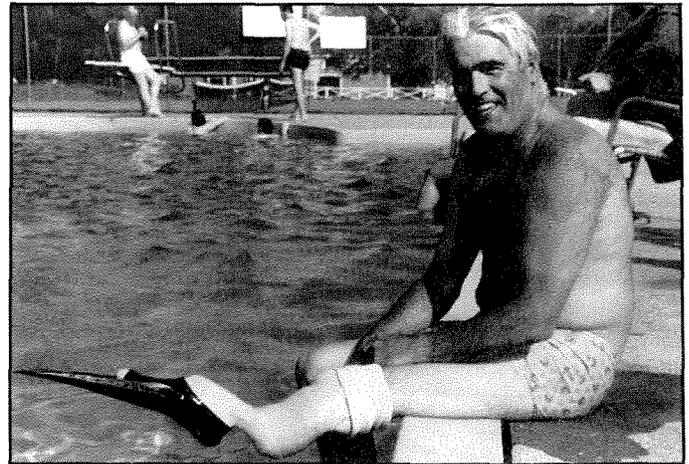
JUDD LUNDT/UCLA PROSTHETICS EDUCATION PROGRAM, LOS ANGELES, CA
A swimmer with bilateral AK amputation is wearing stubbies with fins attached and prepares to enter the water.

that is water resistant.) If the foot is untreated, water will penetrate the foam and eventually cause it to break down prematurely. The foot coatings can be used to waterproof the entire prosthesis.

The ankle and its foot bolt should also be waterproofed to guard against rust. If just the foot and ankle need to be waterproofed, an elastic bootie (available from Otto Bock for adults; a foot cover for children is available from Realistic) can be used over the foot instead of coated treatments. However, the bottom of these booties can tear when walking barefoot on hardened surfaces. If this is a problem, a coating of New Skin or other product



JOHN WOODMANSEE/VAMC, SEATTLE, WA
Waterproof/cosmetic BK prostheses for everyday and water use. From left in the photo: Graphite socket on exoskeletal prosthesis and Seattle Foot (cosmetic treatment: Peyton Massey, Jr., New Life Labs); UCLA CAT/CAM socket with Pelite liner, Seattle Foot and Ankle (cosmetic treatment: Glen Campbell Cosmetic Prosthetics); Ultralight Graphite/Epoxy socket, Teh Lin Graphite pylon and pylon connector, Carbon Copy Foot (cosmetic treatment: Dan Tatum, Cascade Orthopedics). All three legs are treated with New Skin and are waterproof; they were constructed by Albert Rappoport, C.P.



CHAMP MAGAZINE

A swimmer wears the Flipper/Foot with the fin attached to his BK socket.

should be used. These methods are more durable and attractive.

Stubbies for AK swimmers may also be used for walking as well as for entering and leaving the water. A swimmer can use a UCLA CAT/CAM/Narrow ML Flexible Suction Socket, which is an interchangeable socket that will fit into a walking leg.

The Kingsley Beachcomber Foot is the only foot that was originally designed for use in the water. It is also flat-bottomed for barefoot walking. Other types of feet, such as the Otto Bock Foot or the SACH Foot, may be converted to a flat-bottomed barefoot walking position for swimming. This is done by adding a pedilon arch filler treated with a waterproof covering. Many amputees can learn to walk short distances barefoot even without having a fully flat-bottomed heel.

SWIM LEG GUIDE

PEG LEG USED FOR BK OR AK AMPUTATION

- Whomper Stomper, Atlantic Prosthetics
- Orthomedics peg leg
- PVC Pipe with rubber bottom
- Aqualite, USMC

PEG LEG WITH FIN ATTACHED FOR BK OR AK AMPUTATION

SWIM ANKLE FOR FIN USED FOR BK OR AK AMPUTATION*

- VAPC Swim/Walk Ankle
- ActivAnkle

LATEX RUBBER SLEEVE USED ONLY FOR BK AMPUTATION*

- ActivSleeve (various distributors)
- Michigan Sleeve
- Otto Bock Swimming Sleeve (Otto Bock Industries, Inc.)

HOLLOW-CHAMBERED LEG FOR BK OR AK AMPUTATION* †

- Otto Bock Hollow Ultra Light (Otto Bock Industries, Inc.)
- Walt Beneke, Ultra Light, BK (Graphite) (Graphite Prosthesis Manual available from Bee Supply, Reno, NV)

FLAT FOOT FOR BAREFOOT WALKING FOR BK OR AK AMPUTATION

- Beachcomber Foot (Kingsley Mfg.)
- Arch Filler, 2F15 (Otto Bock Industries, Inc.)
- Adjustable Heel Height SAFE Foot (Campbell Childs, Inc.)

WATERPROOF WALKING LEG FOR BK OR AK AMPUTATION

- New Skin (New Skin Labs)
- Elastic Bootie (Foot Cover)
- Otto Bock or Realistic Labs
- Skoat Coat (Daw, Inc.)
- Ultradip

CUFF SUSPENSION FOR BK AMPUTATION

- Otto Bock, Plastic Cuff, 21B16 (Otto Bock Industries, Inc.)

SOLID ONE PIECE EXOSKELETAL WATERPROOFED LEG (NO KNEE) FOR AK AMPUTATION†

- Otto Bock waterproof 3K-9 or 3K-5 (Otto Bock Industries, Inc.)

EXOSKELETAL LEG WITH KNEE LOCK FOR AK AMPUTATION*

- Otto Bock waterproof 3K-9 or 3K-5 (Otto Bock Industries, Inc.)

WATERPROOF SUSPENSION BELT FOR AK AMPUTATION*

- Otto Bock plastic suspension belt 21B17 (Otto Bock Industries)
- TES belt (Neoprene)

STUBBIES WITH AND WITHOUT FINS FOR AK AMPUTATION* †

*Necessary for skin or scuba diving.

†Not a stock item. Must be custom fabricated by your prosthetic facility.

Note: Any of the above types may be combined and custom fabricated.